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**RELIABILITY IMPROVEMENT WARRANTY (RIW) SUPPORT FOR THE  
LIGHTWEIGHT DOPPLER NAVIGATION SYSTEM (LDNS) PROGRAM**

September 1978

Prepared for

PROJECT MANAGER

U.S. ARMY NAVIGATION/CONTROL (NAVCON) SYSTEMS PROJECT OFFICE

FORT MONMOUTH, NEW JERSEY 07703

under Contract F4606-76-A-0087 (DG-04)

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## FOREWORD

This report describes the work performed by ARINC Research Corporation during the period September 1977 through September 1978 for the U.S. Army Navigation/Control (NAVCON) Systems Project Office at Fort Monmouth, New Jersey, under Contract F4606-76-A-0087 (BG-04).

We are indebted to many individuals of the NAVCON Project Office for their assistance during the contract effort. In particular, we wish to thank Mr. John Lombardi for his cooperation and initiative in enhancing our ability to perform the contract tasks.

ABSTRACT

The Lightweight Doppler Navigation System (LDNS) Program is under the management of the U.S. Army Navigation/Control (NAVCON) Systems Project Office at Fort Monmouth, New Jersey.

In December 1976, Singer Company-Kearfott Division was awarded the initial production contract that included the Reliability Improvement Warranty (RIW) terms and provisions.

Prior to this contract effort, ARINC Research Corporation assisted the NAVCON Project Office during the Engineering Development (ED) phase of the LDNS Program and participated in the development of RIW terms and conditions of the Initial Production (IP) solicitation.

Under the current contract effort, ARINC Research provided engineering assistance in defining the Defense Contract Administration Services Office (DCASO) and the manufacturer's warranty responsibilities, in reviewing the contractor warranty data collection plan, and in developing LDNS field implementation plans. This report presents the results of these activities.

## SUMMARY

The U.S. Army Navigation/Control (NAVCON) Project Office at Fort Monmouth, New Jersey, awarded an Initial Production (IP) contract for the Lightweight Doppler Navigation System (LDNS) to the Singer Company-Kearfott Division in December 1976.

In September 1977, ARINC Research Corporation was requested to assist the LDNS Project Office in defining certain aspects of the government-manufacturer interface and in providing guidance in planning for equipment deployment.

The activities in support of the LDNS Program are as follows:

- The NAVCON Quality Letter of Instruction (QUALI) to the Defense Contract Administration Services Office (DCASO), San Diego, California, was reviewed; and recommendations were made concerning their RIW responsibilities.
- Field trips were made to the DCASO and manufacturer's facility at San Marcos, California, for the purpose of reviewing the QUALI with program personnel and observing the manufacturer's production facility.
- A field visit was made to a U.S. Army field organization to observe materiel and documentation flows and to identify any needs for new handling procedures in view of LDNS RIW requirements.
- Assistance was provided in the review and development of materiel flow and handling procedures for the LDNS Supply Bulletin.
- The manufacturer's Warranty Data Collection and Analysis Plan (DI-R-1750) was reviewed, and recommendations were provided concerning its modification.

As a result of these efforts, DCASO and manufacturer RIW responsibilities have been defined and developed, warranty data collection plans have been modified to fulfill program requirements, and field implementation procedures have been recommended to permit more effective handling of LDNS equipments.



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## CHAPTER ONE

### INTRODUCTION

The Lightweight Doppler Navigation System (LDNS) Program is under the management of the U.S. Army Navigation/Control (NAVCON) Systems Project Office, Fort Monmouth, New Jersey.

In June 1974, Engineering Development (ED) contracts were awarded to two contractors. In subsequent Initial Production (IP) proposals, both ED contractors were required to bid on a Reliability Improvement Warranty (RIW) as an alternative to Army organic support for the initial equipment deployment. During IP source selection, RIW was selected as the initial support concept for the LDNS.

ARINC Research Corporation assisted the LDNS Project Office during the ED phase and the IP source selection and provided guidance to NAVCON in developing RIW terms and conditions for the IP solicitation.

Subsequent to the above contract efforts, ARINC Research was requested to assist the Project Office in defining the Defense Contract Administration Services Office (DCASO) responsibility under RIW, in reviewing the manufacturer's warranty data plan, and in developing materiel handling plans and procedures. This report presents the results of these ARINC Research activities.

Chapter Two describes the engineering activities performed by ARINC Research, and Chapter Three presents the conclusions and recommendations resulting from these activities. A list of abbreviations and acronyms is included at the end of Chapter Three.



## CHAPTER TWO

### ENGINEERING ACTIVITIES

Prior to hardware production and field deployment of the LDNS, the NAVCON Project Office believed that certain aspects of the RIW acquisition program would require redefinition of government and manufacturer interfaces. In addition, it was expected that the routine materiel handling roles performed by the U.S. Army field organizations would require modification if the LDNS RIW objectives were to be fulfilled. The support provided by ARINC Research in this study addressed these problem areas. Table 1 presents specific documentation developed during the contract effort.

Table 1. PROJECT DOCUMENTATION		
Item Number	Title	Date
1	Special Report: Warranty Considerations for the Quality Assurance Letter of Instruction (QUALI) - AN/ASN-128 Lightweight Doppler Navigation System	September 1977
2	Special Report: Assist in the Development of Materiel and Associated Documentation Flow Plans for the Lightweight Doppler Navigation System Supply Bulletin	September 1978
3	Special Report: Review of the Singer Company-Kearfott Division Data Collection and Analysis Plan, DI-R-1750, for the Lightweight Doppler Navigation System	September 1977

#### 2.1 DEFINING DCASO PARTICIPATION

The warranty provisions of the LDNS contract created new areas of responsibility for the Defense Contract Administration Services Office (DCASO). DCASO is responsible for overseeing production and quality assurance functions at the manufacturer's facility. It was realized

that RIW considerations in a military procurement situation, such as LDNS, were innovative and would alter traditional patterns of DCASO activity. For example, LDNS RIW would present additional responsibilities for DCASO in the areas of incoming inspection, reparable processing, and bonded storeroom operations. In addition, it was expected that DCASO would play an important role in ensuring that complete and accurate data records, which are required for assessing contract performance, were maintained by the manufacturer.

ARINC Research was tasked to identify DCASO activities affected by RIW and to assist the LDNS Project Office in defining DCASO participation.

In September 1977, ARINC Research participated in a review of a preliminary draft of the NAVCON Quality Assurance Letter of Instruction (QUALI) that tentatively outlined DCASO responsibilities during production and repair of the LDNS. This review was held at the Singer Company-Kearfott Division (S-K) facility in Wayne, New Jersey. Representatives from DCASO-Wayne, the NAVCON Project Office, and ARINC Research attended this review.

After the meeting, ARINC Research formally reviewed the draft. A report was provided to NAVCON (Table 1, Item Number 1) that addressed the following DCASO RIW-related activities:

- Participation in initial inspections
- Monitoring and reviewing of:
  - Failure and repair verification
  - Materiel transactions and cost data
  - Test and repair operations
  - Configuration control
  - Warranty data collection
  - Computerized warranty data processing

Following the QUALI review report, ARINC Research participated in a coordination meeting at the S-K San Marcos facility. The revised QUALI was presented to DCASO and San Marcos personnel. At this time, the QUALI was discussed jointly with S-K and DCASO to ascertain the effect upon the manufacturer's operations and to solicit comments from S-K.

In July 1978, NAVCON and ARINC Research met again to review DCASO responsibilities and to develop an agenda for a DCASO/manufacturer conference. This action was taken since the original DCASO personnel were no longer involved in the project. The purposes of the meeting were to review again DCASO RIW-related activities, to coordinate RIW data-collection requirements with DCASO and the manufacturer, and to elicit comments from

both DCASO and the manufacturer. The agenda developed at this meeting addressed the following:

- Review QUALI
- Consider DCASO-San Marcos reply to the initial QUALI
- Discuss requirements for an emergency backup capability
- Clarify administration of penalty payments and contract adjustments
- Review requirements for a separate "exclusion" repair contract
- Develop guidelines for priority allocation of replacements
- Define procedures for configuration control
- Develop message-handling procedures for replacement requests
- Clarify procedures for reading of Electro-Chemical Indicators (ECI) and for defining final authority responsibilities concerning disagreements
- Observe secure storage area facilities and clarify DCASO responsibilities for its operation
- Discuss U.S. Army field-materiel handling procedure relating to DCASO responsibilities
- Explain the LDNS Supply Bulletin and elicit comments from DCASO
- Discuss status of the LDNS Technical Manual (TM)
- Review procedures for implementation of Engineering Change Proposals (ECPs)
- Discuss and define various administrative procedures for data monitoring and reporting

ARINC Research also participated in the meeting that addressed the above subject areas. These efforts resulted in the development of DCASO/manufacturer interface procedures and increased the comprehension and appreciation of both parties for the LDNS RIW Program requirements.

## 2.2 FIELD SUPPORT PLANNING

The materiel and documentation flows under the LDNS RIW require new procedures to ensure effective use of warranted equipment. As a part of this effort, ARINC Research was tasked to visit a field installation and to study maintenance and supply operations for the purposes of identifying existing procedures and recommending changes required for the LDNS warranty program.

ARINC Research, with concurrence of the Project Office, selected Fort Bragg, North Carolina, as the field installation to be studied. Visits were made to the 782nd Direct Support Unit (DSU), the 517th Transportation Battalion (also a DSU), and the Installation Maintenance (a General Support Unit - GSU) organization.



The materiel and documentation flows were reviewed with organizational personnel. Sample maintenance turnaround times were collected for selected avionics equipment. As a result of this effort, problem areas were identified and alternate approaches were developed regarding materiel flows. The results of this investigation were documented as part of Item Number 2 in Table 1.

The NAVCON Project Office requested that ARINC Research participate in a review of the preliminary draft of the LDNS Supply Bulletin. The purpose of this review was to incorporate into the materiel and documentation flows the experience gained in the field visits.

A series of working discussions were held at NAVCON during June 1978 to modify the preliminary draft of the LDNS Supply Bulletin. These efforts resulted in a "working paper" that reflected the requirements of the LDNS warranty program. This "working paper" was provided to the Supply Directorate, which has responsibility for the final development and dissemination of the Supply Bulletin. A detailed discussion of the evolution of the "working paper" was documented as part of Item Number 2 in Table 1.

These efforts resulted in the development of management concepts and plans for field implementation of the LDNS equipment.

### 2.3 REVIEW OF CONTRACTOR DATA COLLECTION PLAN

The LDNS warranty program requires that the manufacturer provide a Data Collection and Analysis Plan describing how he will accumulate, process, analyze, and present information used in measuring RIW performance.

It was requested that ARINC Research review the Singer Company-Kearfott Division's Data Collection and Analysis Plan (DI-R-1750). This review was documented as shown in Table 1, Item Number 3, and resulted in the following recommendations:

- Include updated Warranty Notice and Install/Removal Label and instructions on filling out these documents
- Include materiel and documentation flow diagrams
- Indicate the data entries and their use for S-K Form 2494, Field Failure Maintenance Event Record (FFMER)
- Use graduated optical magnifying devices for reading the Electro-Chemical Indicator (ECI) scales
- Use ECI readings for replacement LRUs in the FFMER
- Include title space and disposition spaces in the FFMER
- Develop a finalized format and description for the configuration serialization list of the FFMER
- Include data associated with secure storage assets
- Clarify and expand processing procedures for data collection

In addition to providing these recommendations, ARINC Research participated in coordination discussions with the manufacturer at the S-K San Marcos facility in October 1977 and July 1978.

As a result of these efforts, S-K developed a revised Data Collection and Analysis Plan that is consistent with the warranty data collection and processing requirements of the LDNS Program.

## CHAPTER THREE

### CONCLUSIONS AND RECOMMENDATIONS

#### 3.1 CONCLUSIONS

As a result of the study efforts, ARINC Research has assisted NAVCON in anticipating the administrative and management problems associated with fielding LDNS under an RIW program. Specifically, ARINC Research concludes the following:

- The DCASO QUALI reflects the needs of the program.
- The manufacturer's Data Collection and Analysis Plan meets the program requirements.
- The "working paper", which was developed for the Supply Directorate, reflects program-peculiar requirements that should be incorporated in any subsequent Supply Bulletin.

#### 3.2 RECOMMENDATIONS

This contract effort represents an initial step in providing effective control of the LDNS warranty program. It is recommended that an intensive RIW management program be made an integral part of an LDNS implementation program that would include the following activities:

- DCASO operations at the San Marcos facility should be monitored on a periodic basis to ensure that the previously developed plans and procedures are followed. Regular coordination by NAVCON with DCASO could help to anticipate problem areas and could provide for early remedial action.
- Periodic coordination with the manufacturer should be maintained for warranty data collection and program evaluation. The LDNS contractual provisions currently provide for warranty data reporting on a periodic basis. This reporting provides for assessment of the manufacturer's performance but does, however, reflect after-the-fact summaries. Current status assessment could be accomplished through regular on-site discussions between NAVCON and the manufacturer, thereby providing an opportunity to review current operations and program status, to analyze current data, and to discuss problems



or modifications to operations. These activities could be accomplished in conjunction with the DCASO coordination discussed above.

- Visits should be made to organizations using the LDNS equipments, and their operations should be monitored and analyzed to identify problem areas, to assess field warranty performance, and to observe adherence to prescribed procedures. These activities would provide for anticipatory program management and would permit adequate time for implementing corrective action.

## ABBREVIATIONS AND ACRONYMS

DCASO	Defense Contract Administration Services Office
DSU	Direct Support Unit
ECI	Electro-Chemical Indicator
ECP	Engineering Change Proposal
ED	Engineering Development
FFMER	Field Failure Maintenance Event Record
GSU	General Support Unit
IP	Initial Production
LDNS	Lightweight Doppler Navigation System
NAVCON	Navigation/Control
QUALI	Quality Assurance Letter of Instruction
RIW	Reliability Improvement Warranty
S-K	Singer Company-Kearfott Division
TM	Technical Manual